



Armed Forces College of Medicine AFCM



**DEVELOPMENT OF CVS (III)
DEVELOPMENT OF ARTERIES]
[& VEINS**

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INTENDED LEARNING OBJECTIVES (ILO)



- At the end of this lecture, students should be able to:
 - i. Identify the 3 sets of aortic vessels.
 - ii. Recognize pharyngeal arch arteries (aortic arches) & their derivatives.
 - iii. Explain different congenital anomalies of the aortic arches.
 - iv. Identify the 3 pairs of major veins of the embryo.
 - v. Explain different congenital anomalies of the veins.
 - vi. Discuss fetal circulation & its postnatal changes.

Lecture Plan



1. Part 1 (5 min) Introduction
2. Part 2 (40 min) Main lecture
3. Part 3 (5 min) Summary

Key points



1. Aortic arches (pharyngeal arch arteries) & their fate
2. Anomalies of aortic arches
3. Fate of the 3 pairs of major veins
4. Sources & anomalies of SVC & IVC
5. Fetal circulation & its postnatal changes

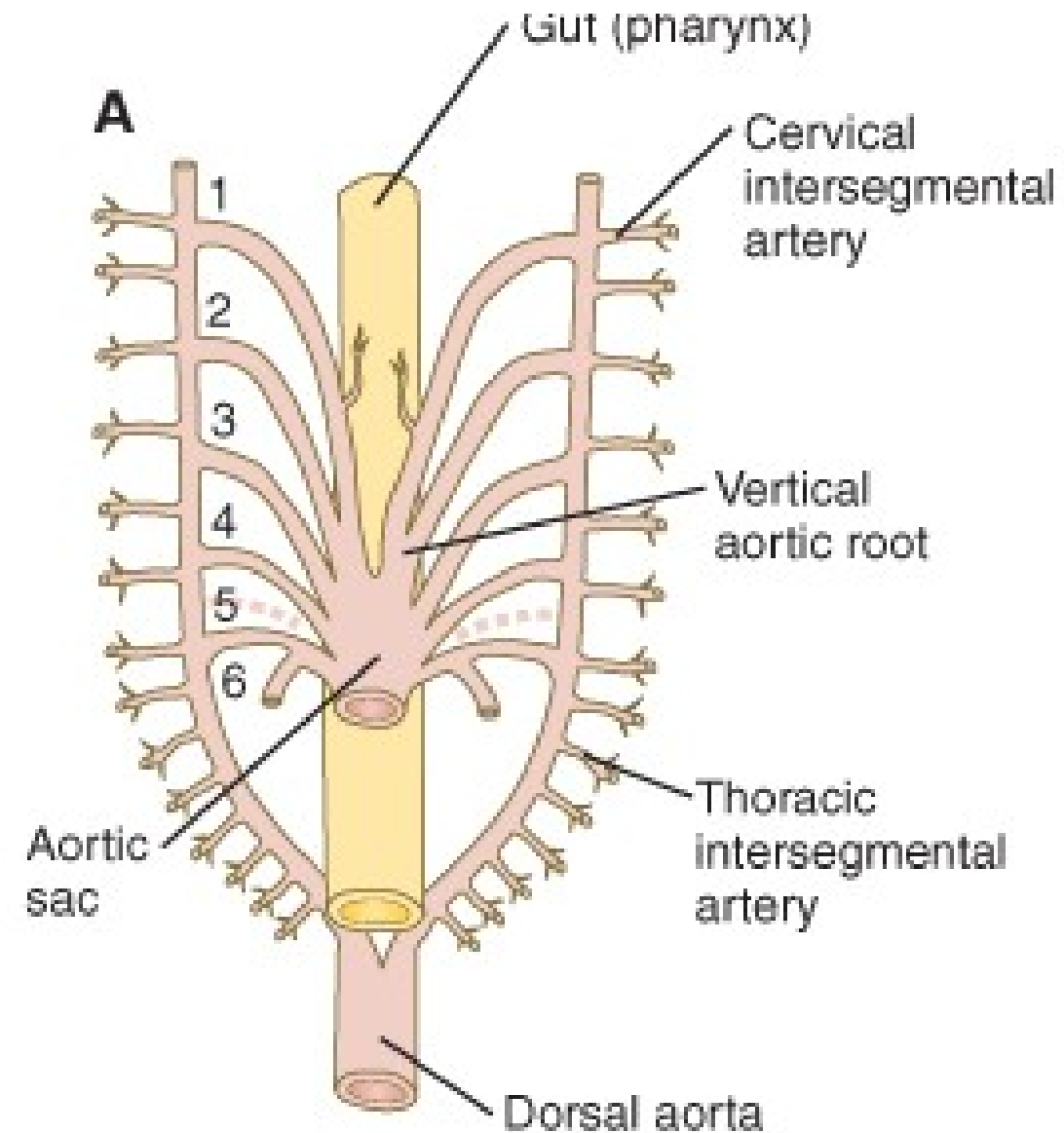
:Development of arteries

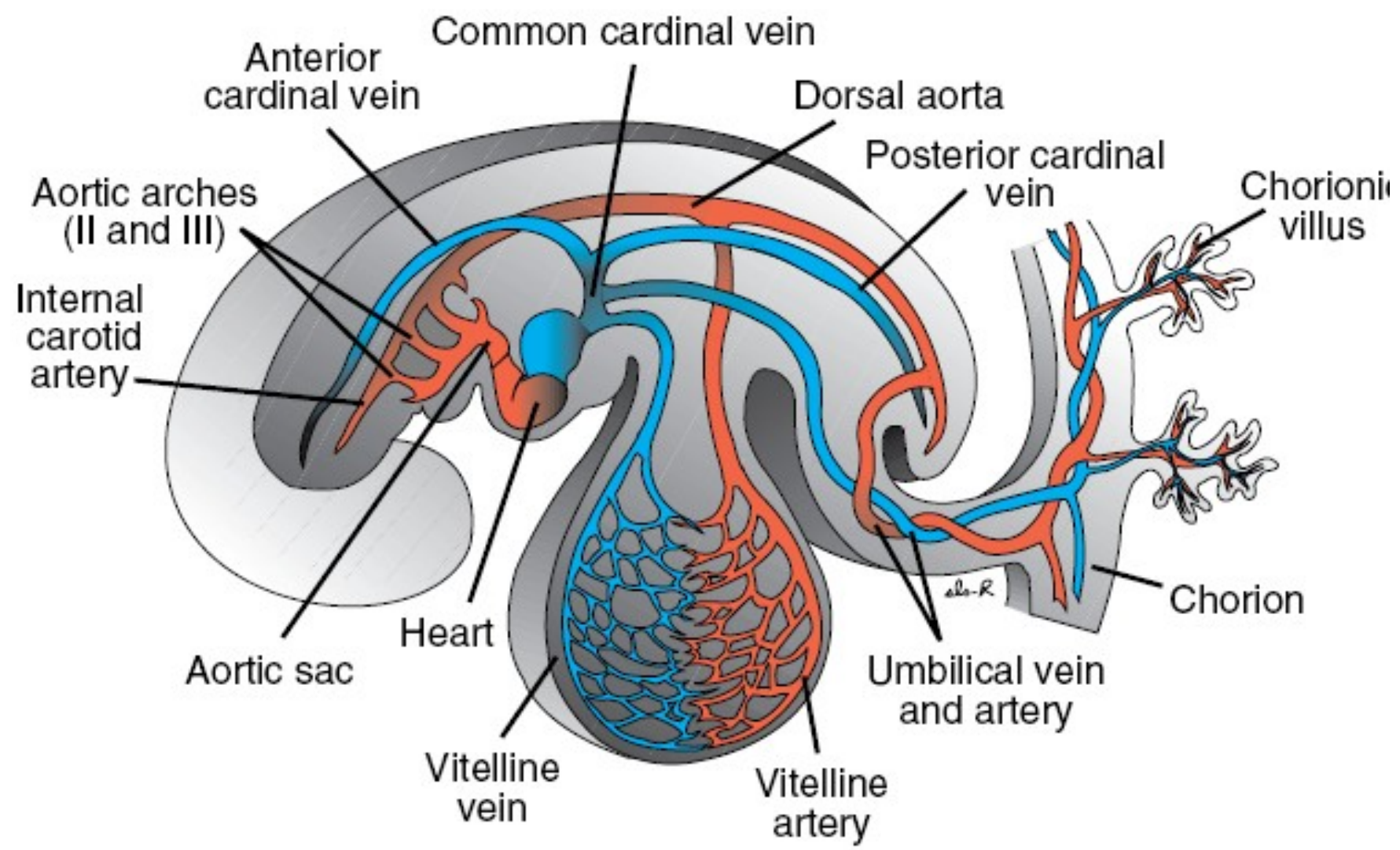
:Occurs as follows

The distal part of truncus arteriosus - is dilated to form the aortic sac. It is formed of a stem and 2 horns

Two dorsal aortae (rt. & Lt.) appear -- Cranially, they are connected to the truncus arteriosus, but caudally they fuse together forming a single dorsal aorta

Six pairs of arteries (Aortic arches) - appear. They connect the aortic sac ventrally with the 2 dorsal aortae dorsally





Waheeb :AORTIC ARCHES

.They are 6 pairs of arteries-

**Each passes in the corresponding pharyngeal -
arch and is called the aortic arch artery**

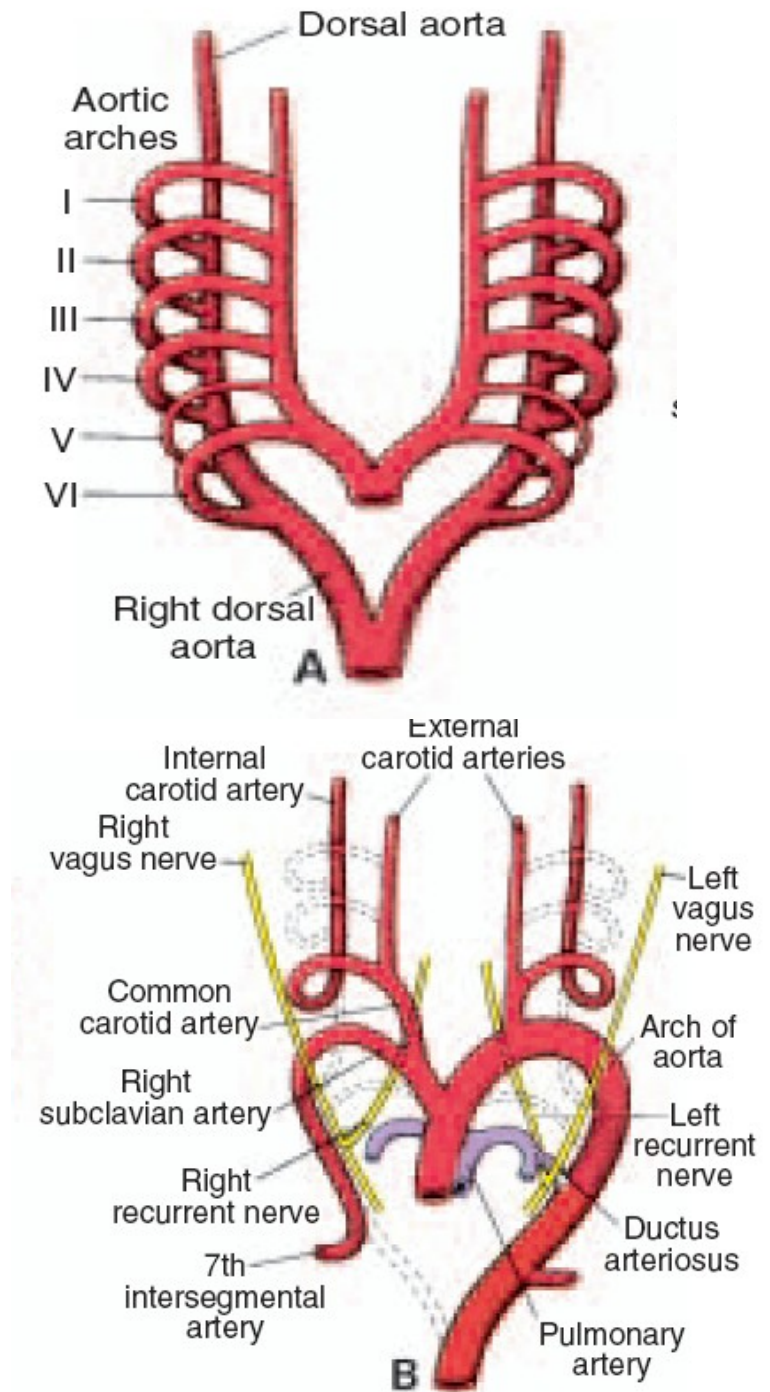
**They are never present at the same time, as -
by the time the 3rd pair develops the 1st pair
.disappears**

:Fate of the aortic arches

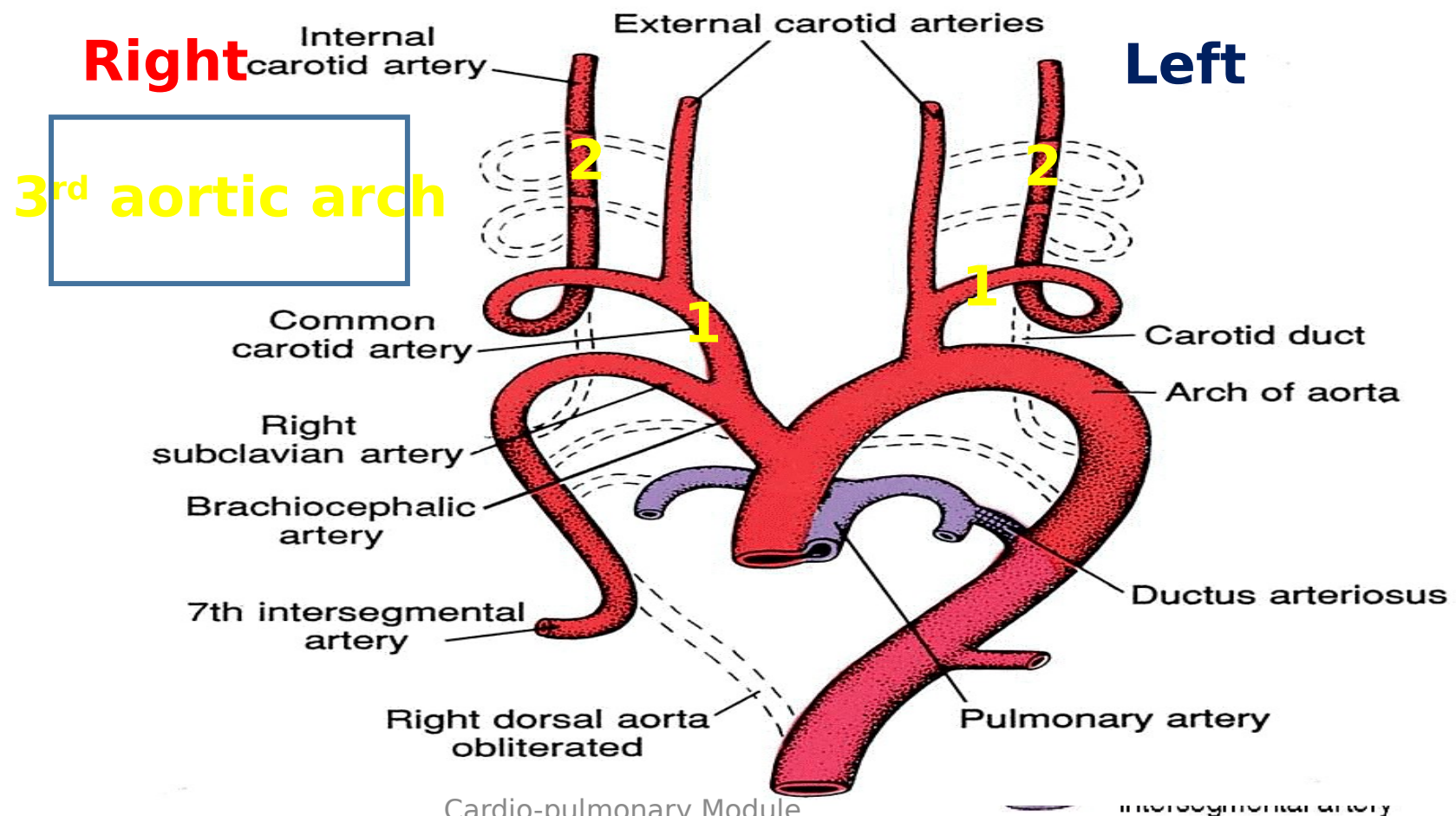
**They undergo changes in number and
:arrangement as follows**

**1st : disappears in both sides except for a small
.part which forms the maxillary artery**

**2nd : disappears in both sides except for a small
part which forms the stapedia and hyoid
arteries**



Waheeb **3rd** : forms the common carotid and the proximal part of internal carotid arteries. (the external carotid arises as a bud from the 3rd arch).

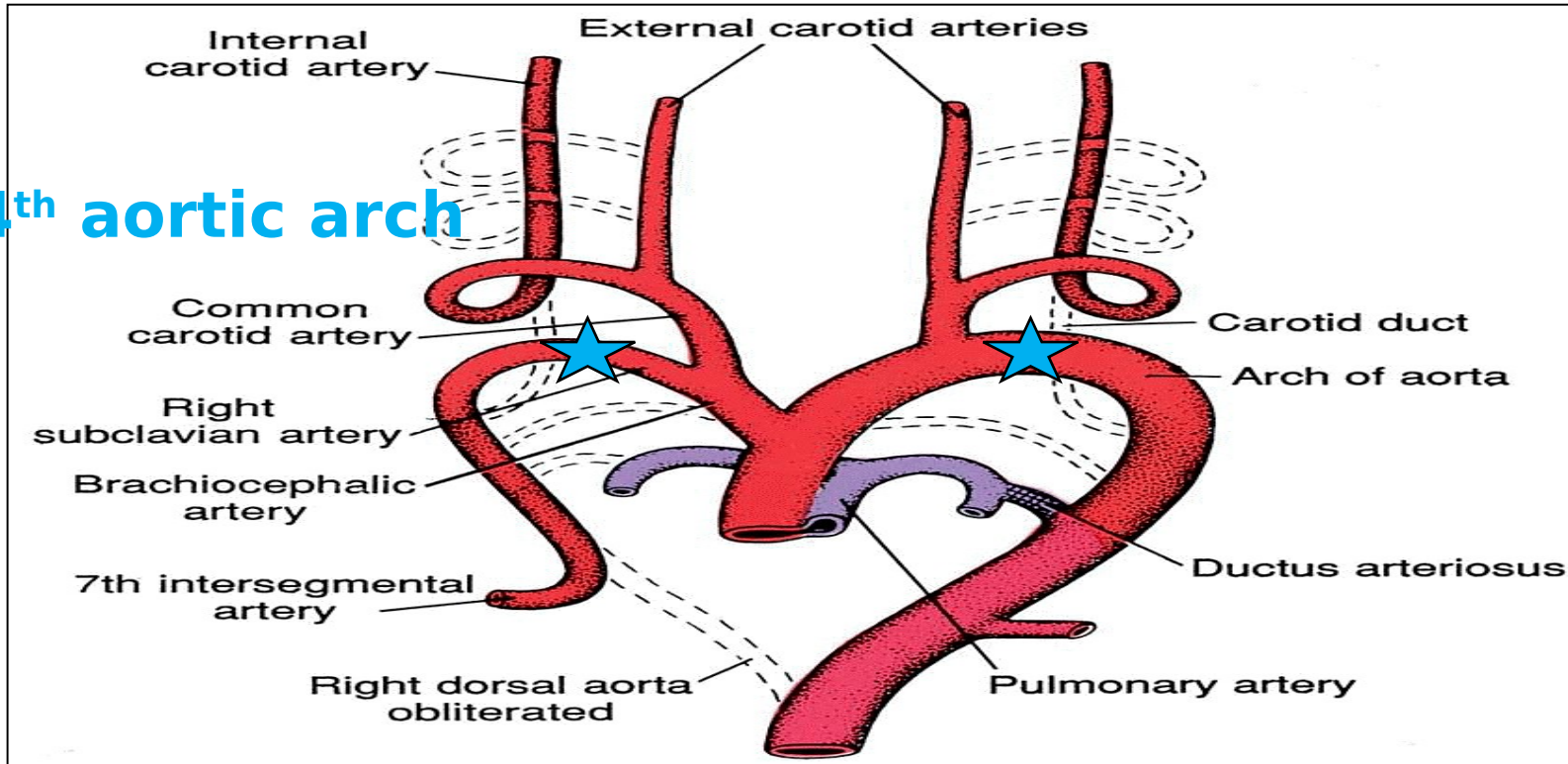


Waheeb

4th : - On the Rt. side it forms the proximal part
of the rt. Subclavian artery

On the Lt. side it forms the middle part of -
the arch of aorta

4th aortic arch



Waheeb

5th : disappears very early and completely on
.both sides

6th : each arch divides into ventral and dorsal
.segments

:on the rt. Side -

The ventral segment forms the rt.

.Pulmonary artery

.The dorsal segment disappears

:On the lt. side-

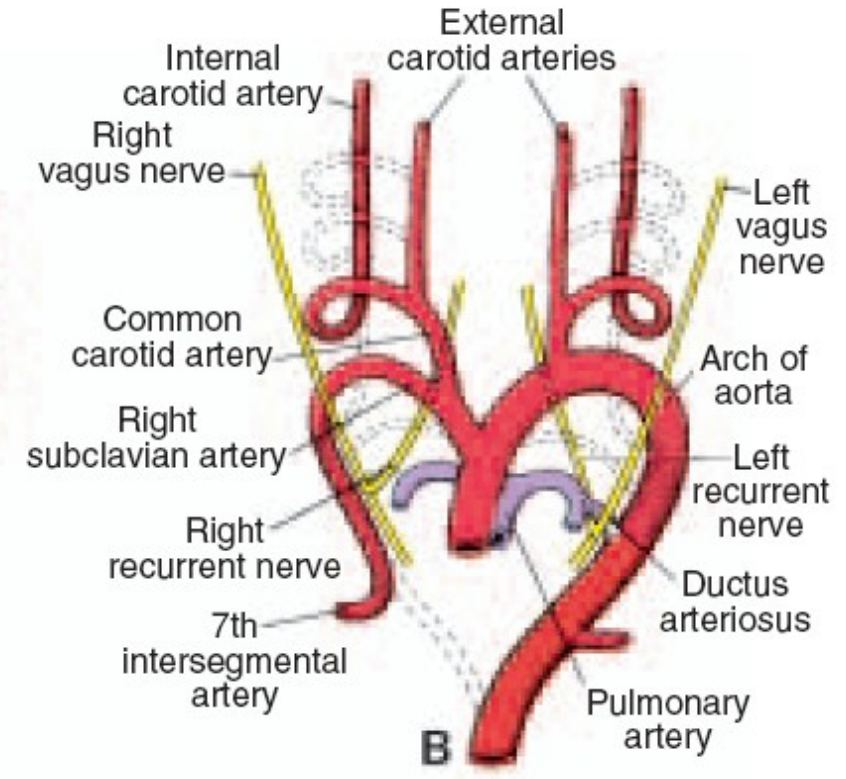
**The ventral segment forms the Lt. pulmonary
artery**

**The dorsal segment persists
during intrauterine life forming the ductus
arteriosus connecting the Lt. pulmonary**

.artery to the arch of aorta

:Fate of the aortic sac

The Rt. horn form the brachiocephalic -



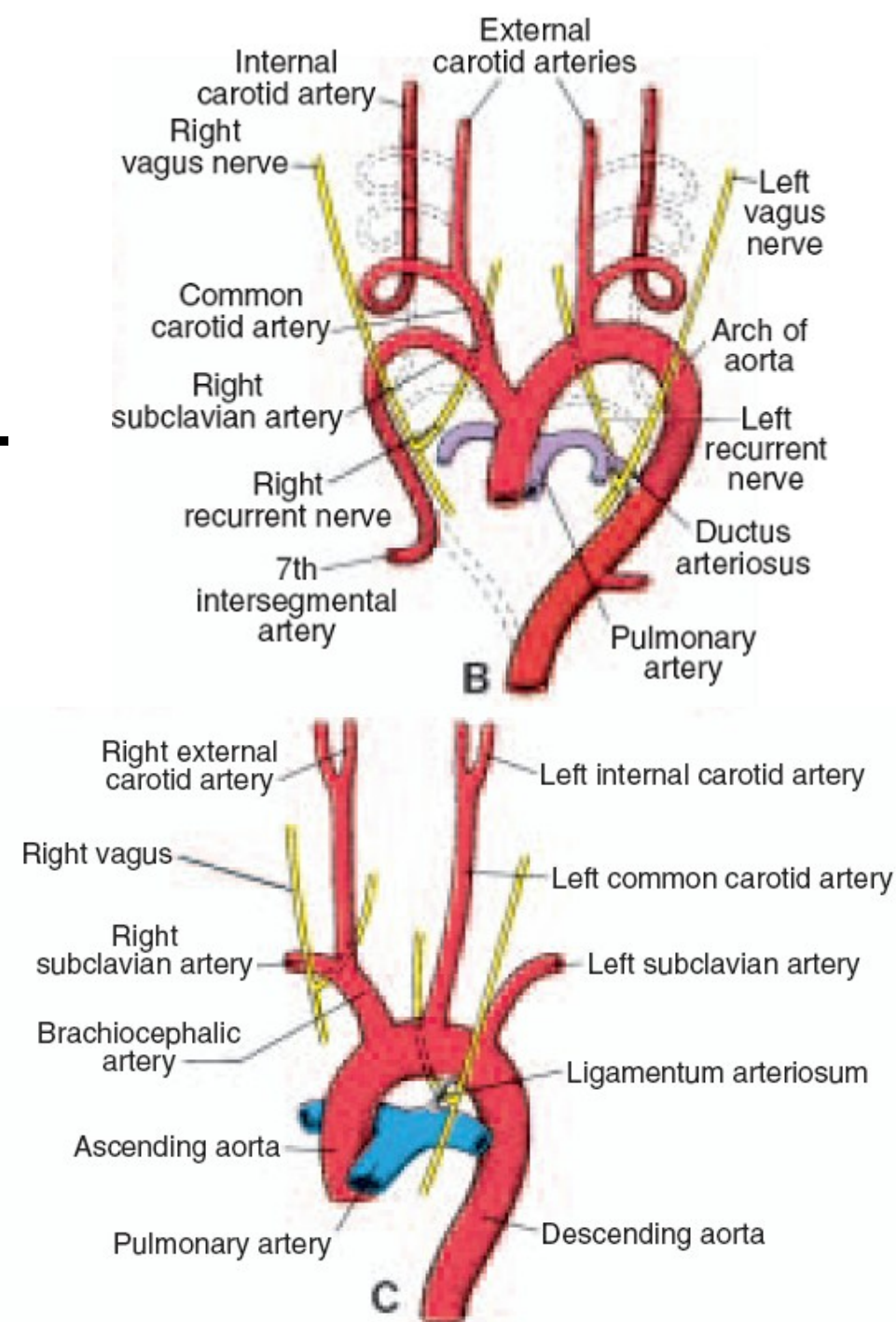
.N.B

**The recurrent laryngeal nerve is the -
nerve of the 6th pharyngeal arch**

**Due to caudal migration of the heart, the -
nerve is pulled down by the 6th aortic arch
forming a loop before it returns to the
neck**

**On the Lt. side: the recurrent
laryngeal nerve hooks around the ductus
arteriosus**

**On the Rt. side: hooks around the rt.
subclavian artery in the neck (because
the 5th & dorsal part of 6th arches
disappear)**



Important note



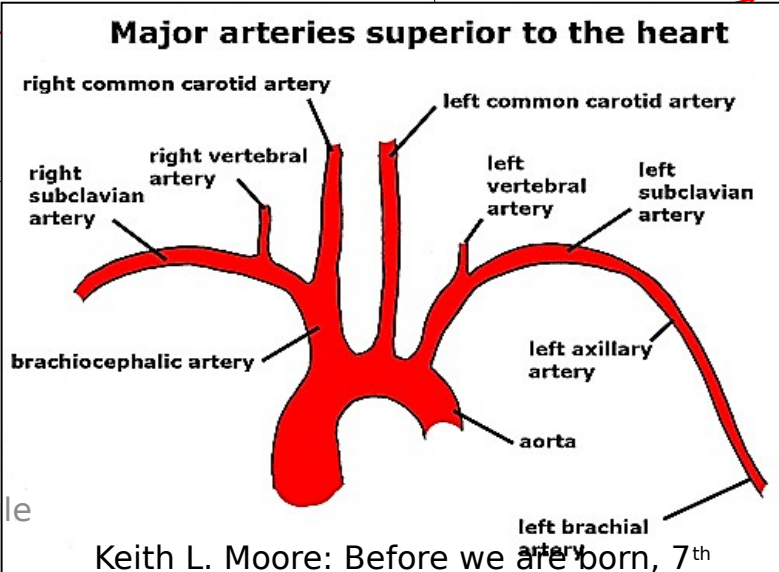
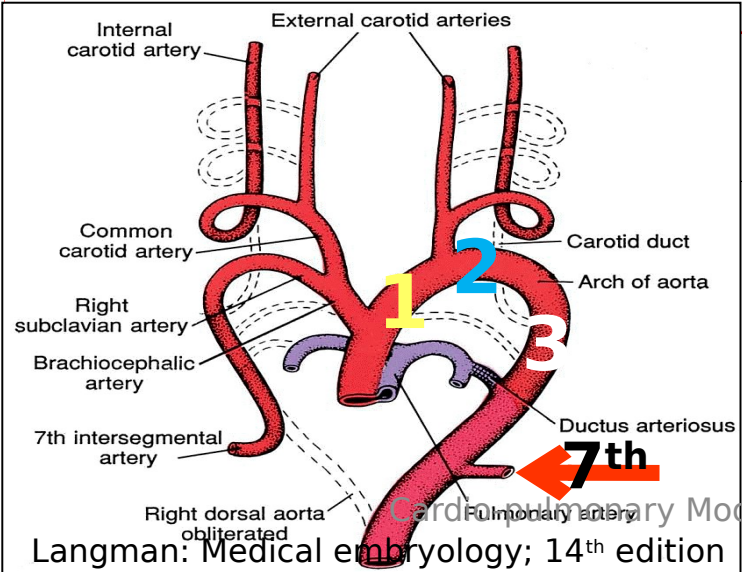
♣ **The arch of aorta is derived from 3 sources:**

Proximal part → Aortic sac.

Middle part → Left 4th aortic arch.



Left dorsal aorta is not derived from an aortic arch. It is derived from **left 7th intersegmental A. & shifts cranially.**



Waheeb :Anomalies of arteries

**Patent ductus arteriosus -1
(PDA): occur alone or 2ry to
.coarctation of aorta**

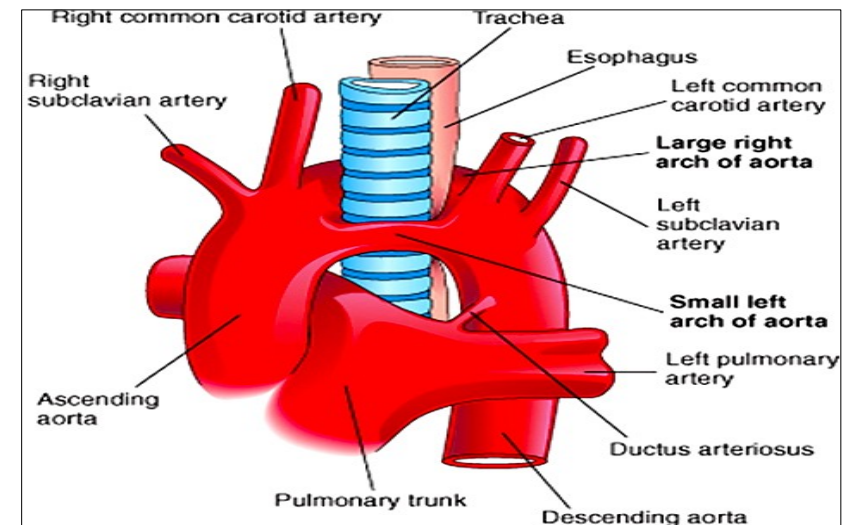
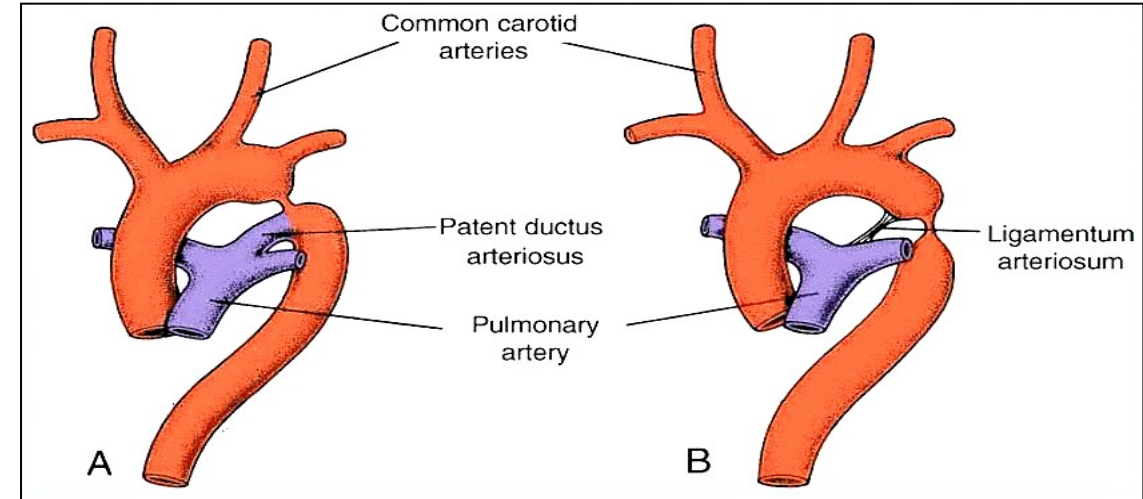
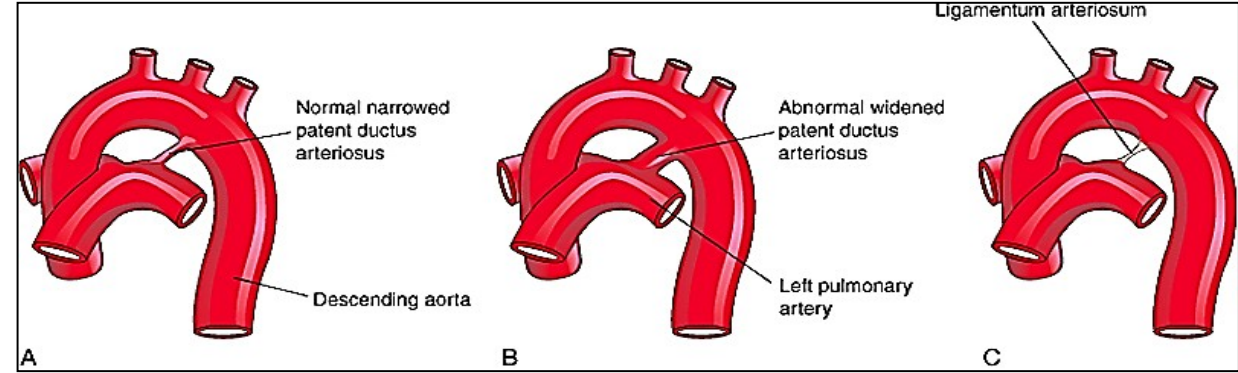
**Coarctation of aorta: narrowing -2
of a segment of aorta, it may be
preductal (PDA) or postductal
.(no PDA)**

:Anomalies of the arch -3

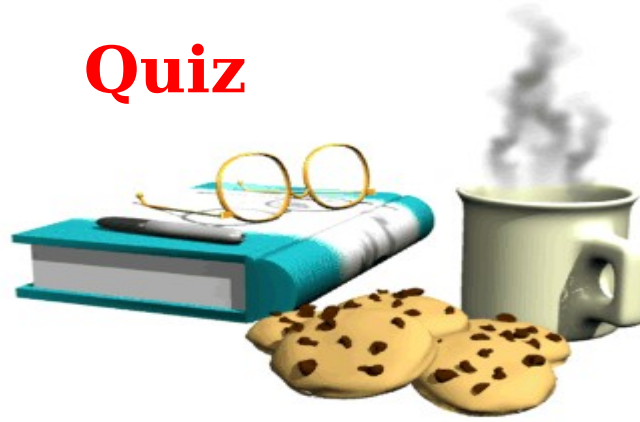
**Double aortic arch forming -
a vascular ring around the
.trachea and oesophagus**

**Rt. aortic arch (reversal of the -
.normal)**

Interrupted aortic arch -



Quiz

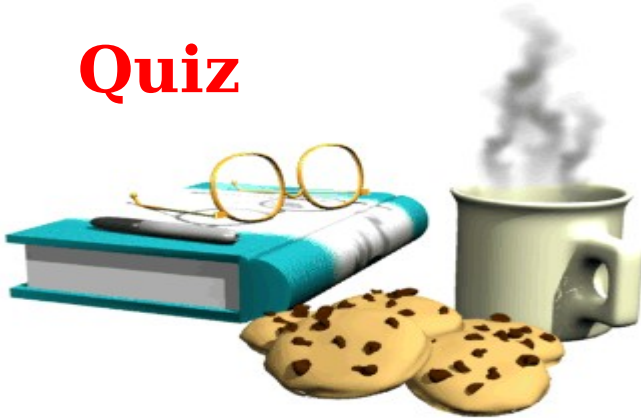


■ **Left subclavian artery is derived from:**

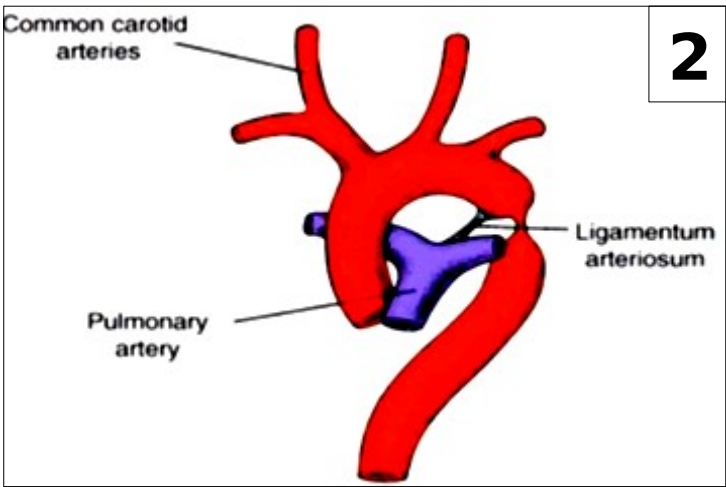
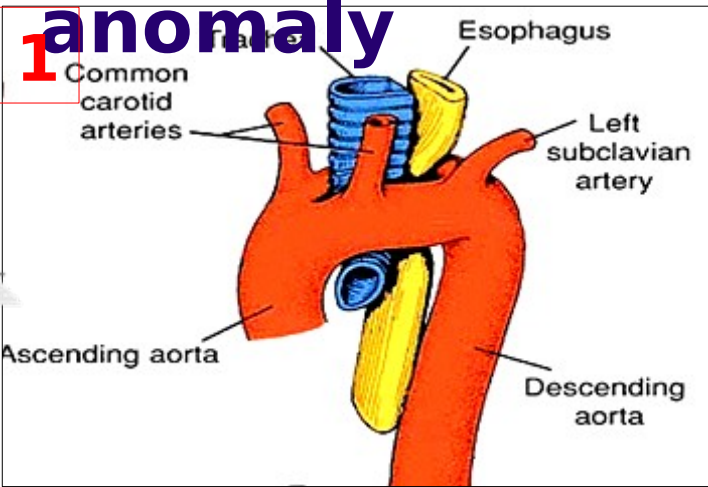
- a. 3rd aortic arch
- b. 7th intersegmental A_{*}
- c. 4th aortic arch
- d. Left part of aortic sac
- e. 6th aortic arch

■ **List the primordia (sources) of the aortic arch.**

Quiz



Identify the anomaly





♣ The 3 pairs of major veins of the embryo open into right & left horns of sinus venosus.

A] **Vitelline veins**: *Right & left*

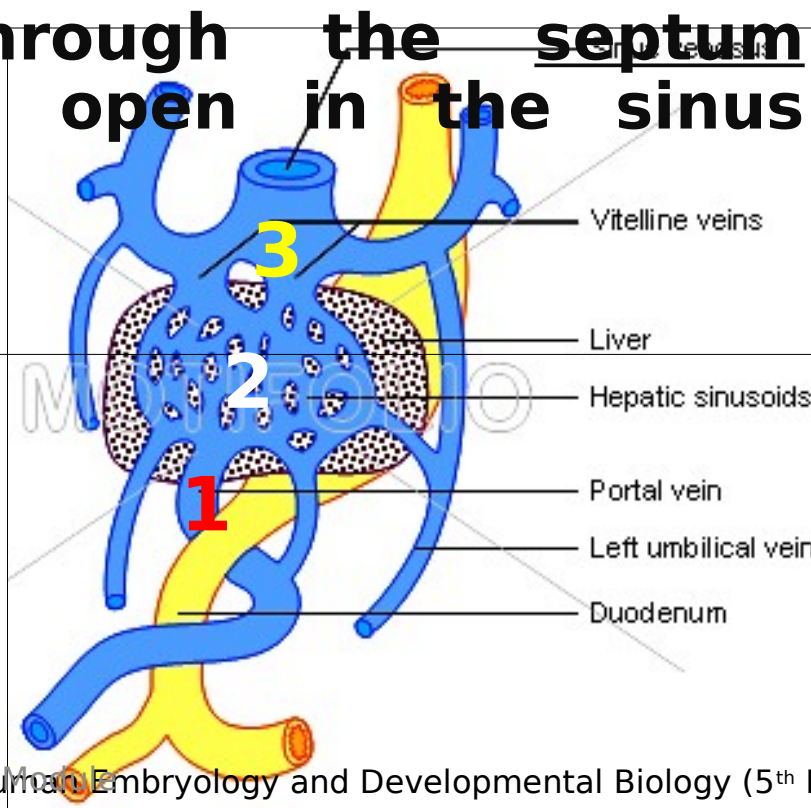
-2 veins which drain the yolk sac & gut.

■ **Fate of vitelline veins**: They pass through the septum transversum to open in the sinus venosus.

1-Caudal septum transversum ⇒ 8-shaped anastomosis around the duodenum ⇒ **Portal vein**.

2-Within septum transversum ⇒ They become interrupted by growing cords of liver cells ⇒ **Hepatic sinusoids**.

3-Between septum



B] Umbilical veins:

-2 veins which carry oxygenated blood from the placenta to the sinus venosus after passing through the septum transversum.

■ Fate:

-Right vein disappears.

-Left vein:

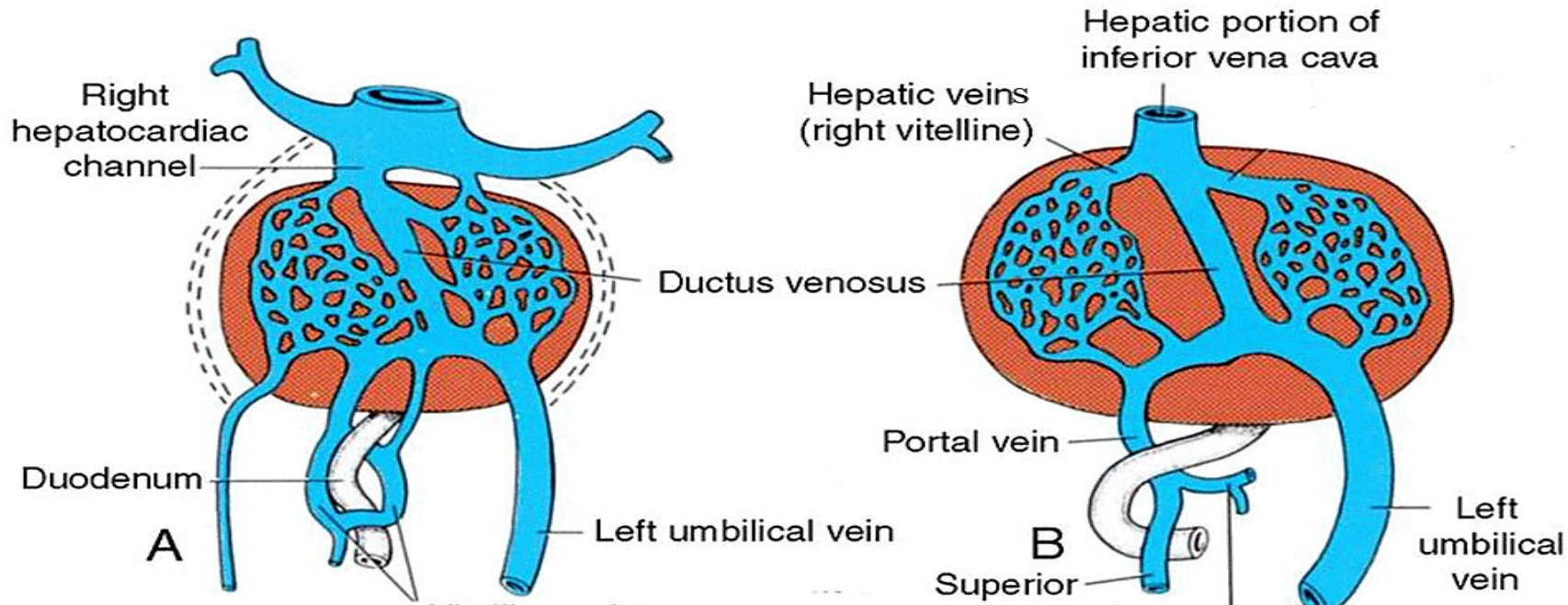
1. Part between septum transversum & sinus venosus disappears.

2. Part inside the septum transversum ⇒ **Ductus venosus**.

3.

th

connects



Waheeb :C- Cardinal veins

There are 2 common -
cardinal veins , each is
formed by the union of
anterior and posterior
cardinal veins

They drain venous blood -
from the body wall and
in the sinus venosus

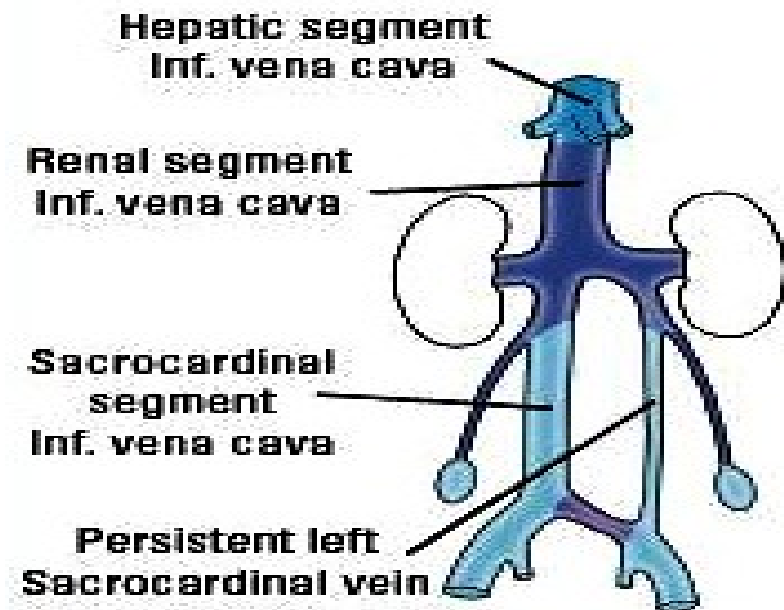
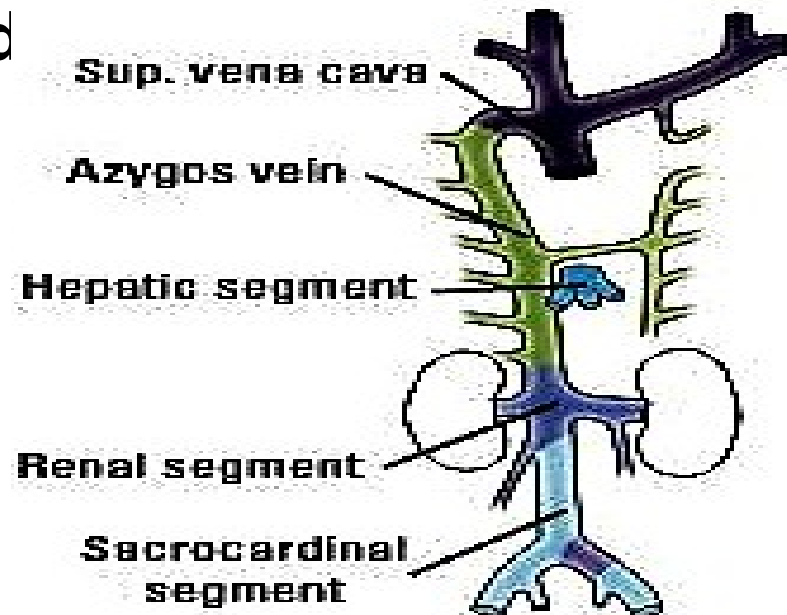
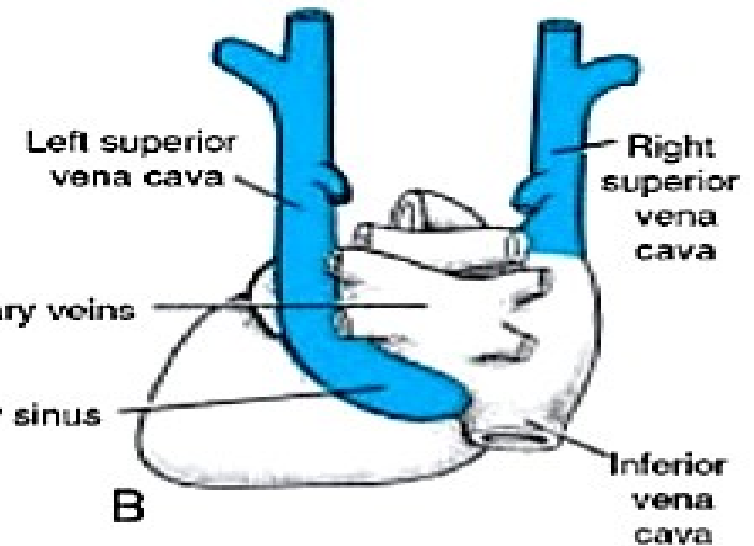
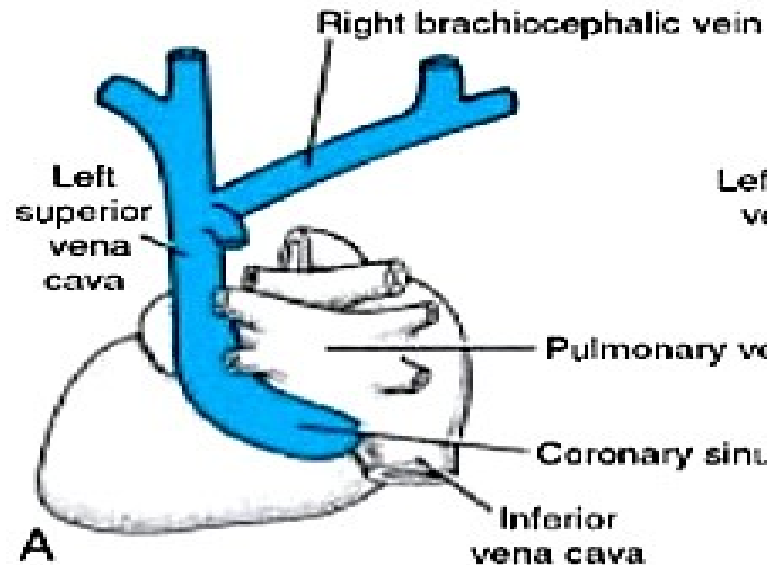
They form the caval -
system

:Anomalies of veins

.Double SVC -1

.Lt. SVC -2

Double IVC -3



FOETAL CIRCULATION

Waheeb

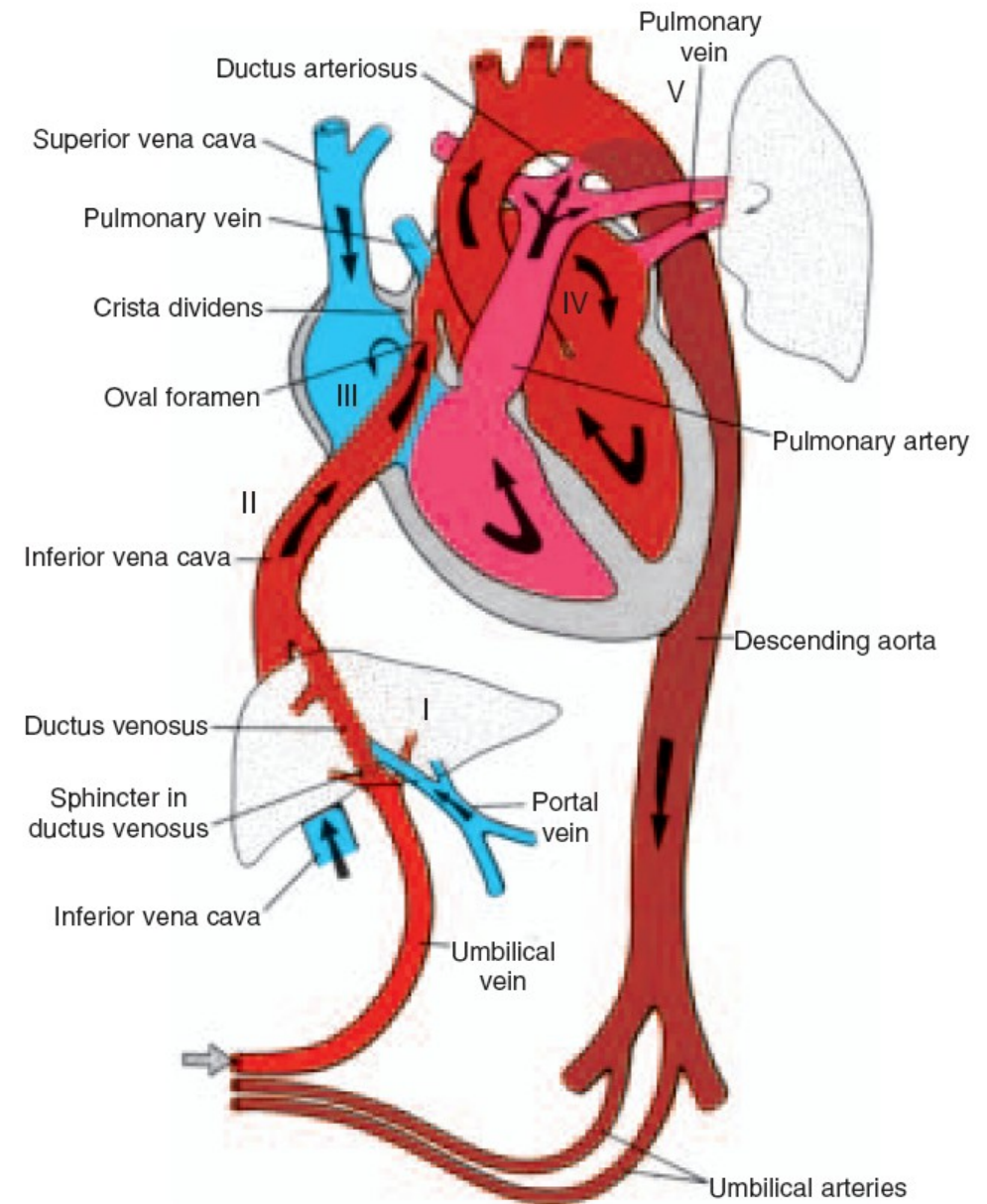
**There is no respiration, so the -
placenta acts as a lung for oxygenation
of the foetal blood**

**The oxygenated blood is carried from
the placenta to the foetus via the Lt.
umbilical vein which passes to the liver**

**In the liver, most of the oxygenated -
blood passes through the ductus
venosus to reach the IVC**

**The IVC carries the oxygenated blood -
(from the placenta) ,which mixes with
little amounts of deoxygenated blood
reaching the IVC from the lower 1\2 of
the body, to the Rt. atrium**

**In the Rt. atrium, most of the blood-
from the IVC is directed through the**



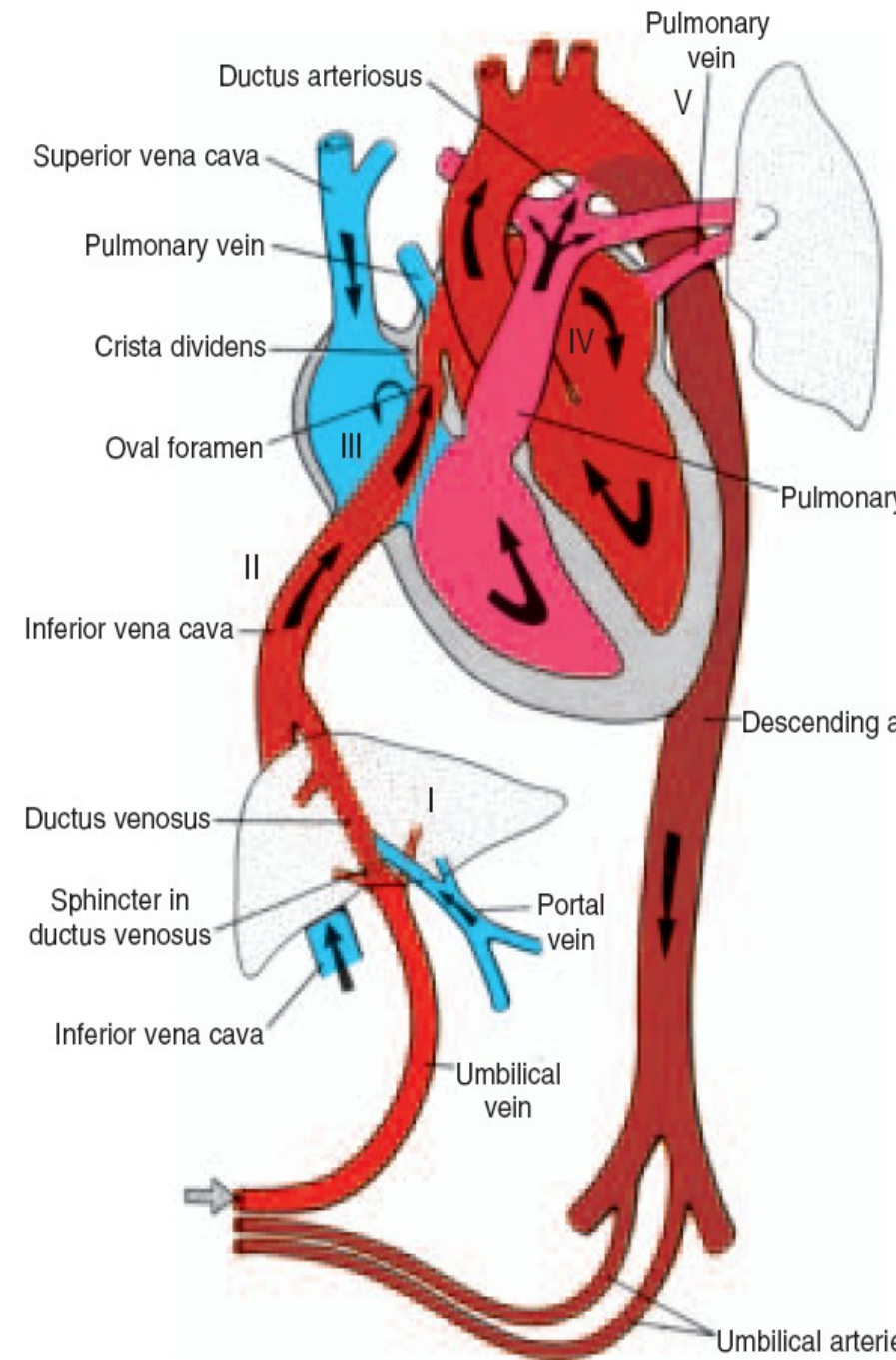
Waheeb

From the Lt. atrium, blood passes to the - Lt. ventricle and aorta and then distributed .mainly to the heart, U.L. & head and neck

The deoxygenated blood:carried by the SVC reaches the Rt. atrium where it passes directly to the Rt. ventricle then to the .pulmonary trunk

From the pulmonary trunk, little amount of - blood passes to the lung while the majority passes through the ductus arteriosus to reach the distal part of the arch of aorta .where it mixes with the oxygenated blood

The dorsal aorta carries partially - oxygenated blood which is distributed to the abdomen , lower limbs and finally passes through the 2 umbilical arteries to the placenta to be oxygenated and returned



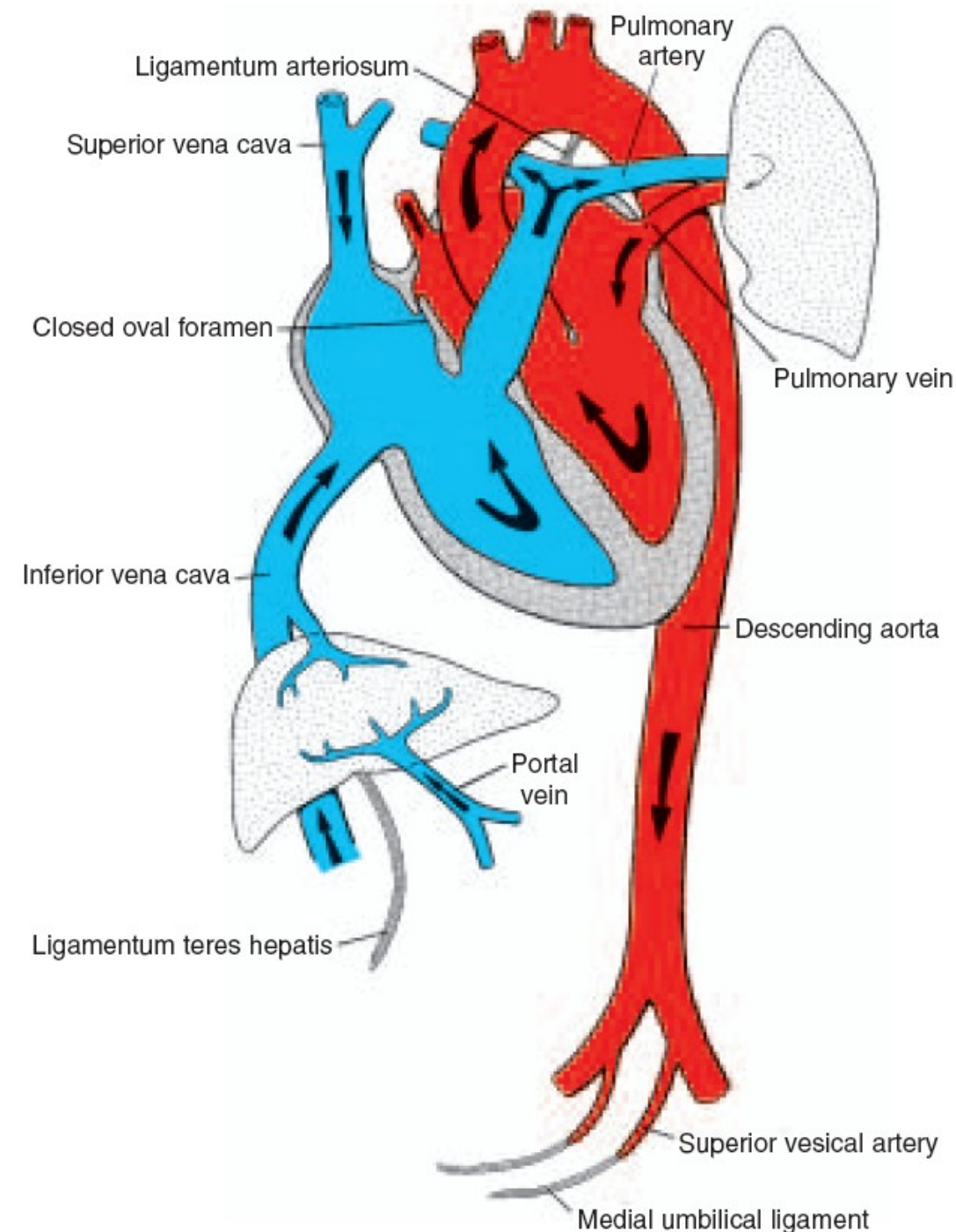
Waheeb :Changes in the circulation after birth

:Immediate changes

Immediately after birth, the lung - expands causing negative intra-thoracic pressure leading to suction of blood into the lungs and establishment of pulmonary .circulation

The increased pressure in the Lt. - atrium together with the decreased pressure in the Rt. atrium causes firm apposition of the septum primum to the septum secundum leading to closure of the foramen .ovale

The ductus arteriosus becomes -



Waheeb
:Late fibrotic changes

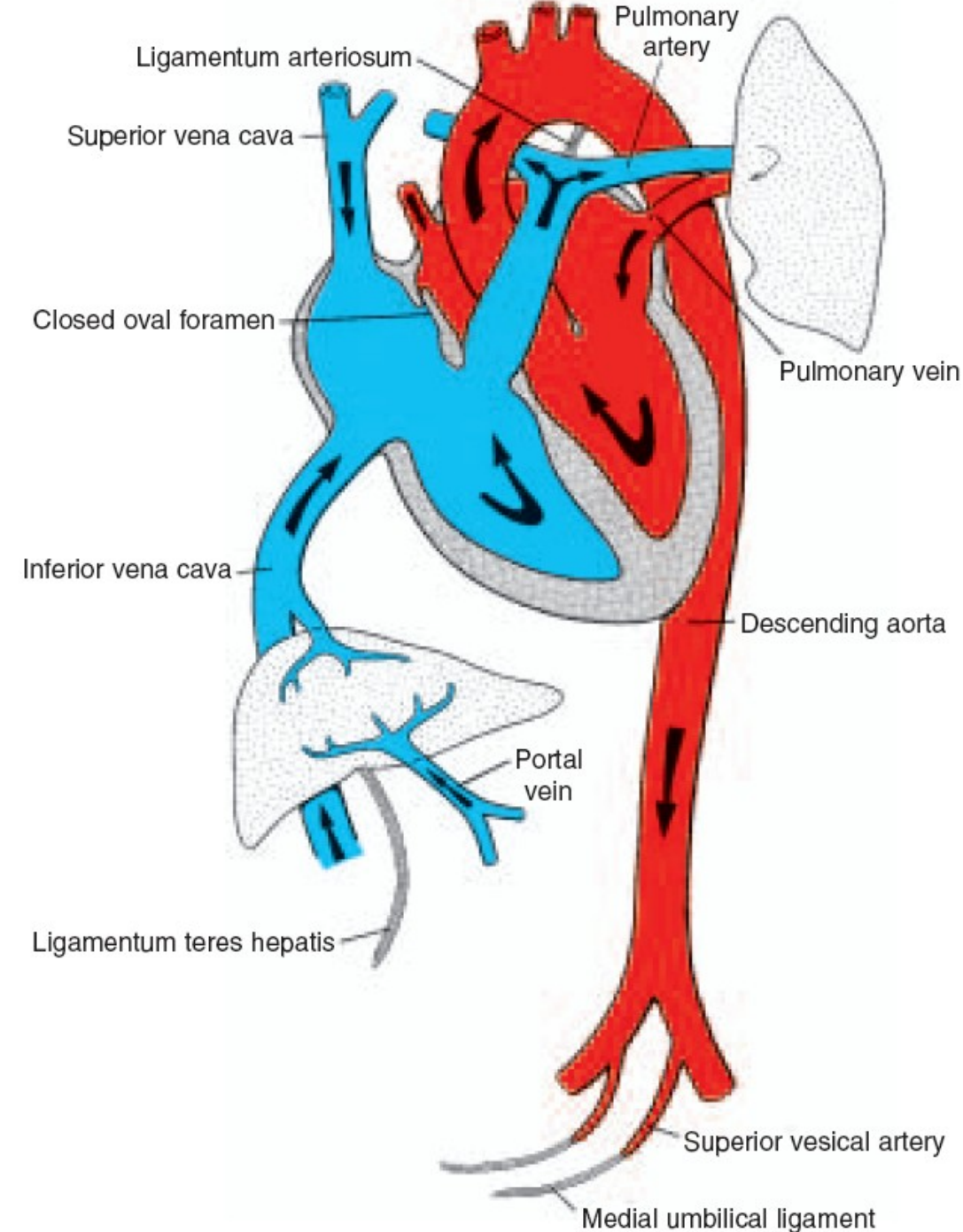
During the 1st year of postnatal life - some of the vessels become fibrosed .and change into ligaments

The Lt. umbilical vein: becomes the -1 .ligamentum teres of the liver

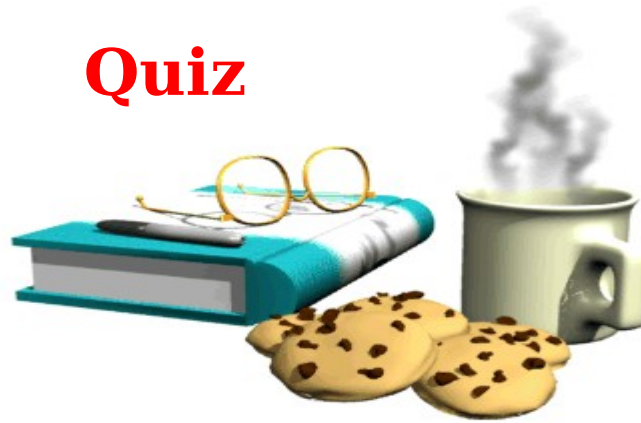
The ductus venosus: becomes the -2 .ligamentum venosum

Ductus arteriosus: becomes -3 ligamentum arteriosum connecting the Lt. pulmonary artery with arch of .aorta

The umbilical arteries: become the -4 lateral umbilical ligaments. Their proximal part remains patent gives superior vesical arteries



Quiz

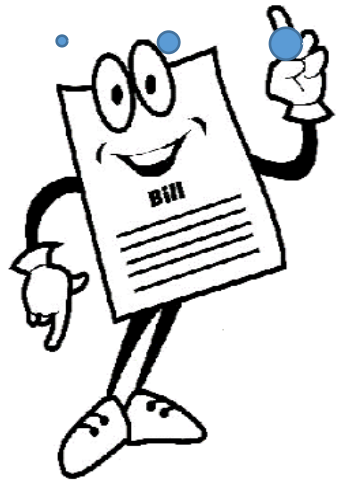


■ **In fetal circulation, highest level of oxygenated blood is present in:**

- a. Left atrium**
- b. IVC**
- c. Arch of aorta**
- d. Left umbilical* vein**
- e. Left ventricle**

■ **List the 3 shunts in fetal circulation.**

Lecture Summary



Arteries & veins

- There are 3 sets of aortic vessels & 6 pairs of aortic arches
- The arch of aorta is derived from 3 sources
- Anomalies of the aortic arches** include PDA & 4 anomalies of arch of aorta; Coarctation, double, right & interrupted arch of aorta
- There are 3 pairs of major veins (at 4th week): Vitelline, umbilical and cardinal veins.
- 3 shunts** are essential in the fetal circulation & 3 types of blood are present according to O₂ content.

SUGGESTED TEXTBOOKS



1. Keith L. Moore: Before we are born, essentials of embryology and birth defects; 7th edition.
2. Langman: Medical embryology; 14th edition.
3. Web sites: <https://studentconsult.inkling.com/>
<https://www.clinicalkey.com/student>

